Geographic distribution and changes in population densities of waterfowl in the Northwest Territories, Canada, 1976-2003

Bonnie J. Fournier and James E. Hines

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ABSTRACT

This report summarizes, in a series of maps, the distribution of several common types of waterfowl throughout much of the mainland (707,589 km^2) of the Northwest Territories, Canada. The aerial survey data used in mapping represent part of a much larger dataset collected each year by the US Fish and Wildlife Service, Canadian Wildlife Service, and other collaborators during the Waterfowl Breeding Population and Habitat Survey. Six strata have been delineated in the Northwest Territories and 25 transects are surveyed by fixed-winged aircraft each year. Data from each 29-km transect segment were geographically coded and so could be used in Geographic Information System mapping of waterfowl densities following an Inverse Distance Weighting approach. Data from 1976-2003, a period when the surveys had become highly standardized, were used in production of the density maps. By comparing, earlier (1976-1980) and more recent (1999-2003) count data, locations where numbers of waterfowl may have increased or declined are identified. Among the common types of waterfowl considered are Mallard, American Wigeon, Northern Pintail, Green-winged Teal, Blue-winged Teal, Northern Shoveler, Canvasback, Ring-necked Duck, Bufflehead, Long-tailed Duck, Canada Goose, and five general species groups (scaup, goldeneyes, scoters, mergansers, and swans). Given the potential for industrial development in the region, the maps should be of immediate application in wildlife management, environmental impact assessments, and general conservation planning.

105-06250/

RÉSUMÉ

Grâce à une série de cartes, ce rapport résume la répartition de plusieurs espèces de sauvagine communes dans la majeure partie continentale (707 589 km^2) des Territoires du Nord-Ouest, au Canada. Les données de relevé aérien qui ont servi à dresser les cartes font partie d'un ensemble beaucoup plus grand de données recueillies chaque année par le US Fish and Wildlife Service, le Service canadien de la faune et d'autres collaborateurs dans le cadre du relevé des populations reproductrices et des habitats de la sauvagine. Six strates ont été établies dans les Territoires du Nord-Ouest, et le relevé a été effectué par avion sur 25 transects chaque année. Les données pour chaque segment de transect de 29 km ont été géoréférencées afin de cartographier les densités de sauvagine à l'aide d'un système d'information géographique et de la méthode de pondération par distance inverse. Les cartes de densité ont été produites à partir des données recueillies de 1976 à 2003, une période pour laquelle les relevés étaient très normalisés. Les endroits où l'abondance de la sauvagine aurait augmenté ou diminué ont été relevés en comparant les données de dénombrement du début (1976-1980) et de la fin (1999-2003) de cette période. Les espèces de sauvagine étudiées comprennent le canard malard, le canard siffleur d'Amérique, le canard pilet, la sarcelle d'hiver, la sarcelle à ailes bleues, le canard souchet, le fuligule à dos blanc, le fuligule à collier, le petit garrot, l'harelde kakawi, la bernache du Canada, ainsi que cinq groupes d'espèces généraux (fuligule, garrots, macreuses, harles et cygnes). Étant donné le potentiel de développement industriel de la région, les cartes peuvent servir immédiatement à la gestion de la faune, à des évaluations environnementales et à la planification générale en matière de conservation.

ACKNOWLEDGEMENTS

The data summarized in this report represent the collective efforts of many contributors, most notably the pilot-biologists and observers who carried out the surveys and the many individuals who have been involved in managing the database over the years. We would like to specifically acknowledge the assistance of Alan Davenport, GIS Coordinator, U.S. Fish & Wildlife Service, Division of Migratory Bird Management, Laurel, Maryland, in clarification of stratum, transect, and segment locations.

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1. INTRODUCTION

The U.S. Fish and Wildlife Service and the Canadian Wildlife Service, in cooperation with others, have conducted annual aerial surveys of breeding waterfowl throughout much of central Canada, the north-central United States, and Alaska since 1955. The Waterfowl Breeding Population and Habitat Surveys provide reliable information on the spring population size and trajectory for many common species of waterfowl in North America. The resulting data are used in the establishment of hunting regulations in the United States and Canada and provide long-term information that is critical for effective conservation efforts. Most of the vast boreal and sub-arctic area region of the Northwest Territories is included within the area surveyed each year.

The information on waterfowl numbers recorded during the surveys are geographically referenced and thus are suitable for mapping with a Geographic Information System. It is the primary objective of this report to summarize the long term data in a series of maps, depicting the distribution of some common waterfowl species on the mainland of the Northwest Territories. By comparing, earlier and more recent count data, locations where waterfowl numbers may have increased or declined are identified as well.

2. METHODS

For survey purposes, six strata have been delineated in the Northwest Territories according to broad geographic and habitat characteristics (Table 1, Figure 1). Twenty-five transects, each divided into 29-km long segments, are surveyed during late May and early June of each year. The number of waterfowl counted along the transect route are entered into a computer database with the transect segments serving as a basis for recording the data. Parts of two strata (numbers 16 and 18) extend into northern Alberta. For the purpose of this report, we have used only data from those strata when transects were completely within the Northwest Territories. Between 1955 and 1975, the survey design went through a period of gradual modification as a number of additional transect segments or entire transects were added. The survey design has remained consistent since 1976 so we chose to map only the data collected since that year.

The segment-level database, derived from the Waterfowl Breeding Population and Habitat Survey was obtained online through the FWS/USGS Migratory Bird Data Center (http://mbdcapps.fws.gov/). Variables in this database include year, stratum, transect, and segment identifiers, species, and the number of single drakes, pairs, and flocked waterfowl counted by the aerial survey crew. We decided to use "total indicated birds" for this report and used data that had been corrected for visibility bias. The visibility correction factors applied to raw segment counts have been derived from a comparison of ground (or helicopter) counts and the counts from fixed-wing aircraft (Smith 1995).

Survey procedures for the Waterfowl Breeding Population and Habitat Survey are described in detail by Smith (1995) and a description can be found online at http://www.fws.gov/birddata/databases/mas/aboutmas.htm. Additional detail concerning stratum boundaries and the location of transects and segments can be viewed interactively at http://mbirdims.fws.gov/nbii/.

The survey area shown on our maps includes 6 strata and covers approximately 707,589 km^2 (Table 1, Figure 1). Two types of maps are presented: (1) density contour maps showing the broad distribution of each species in the survey area; and (2) trend maps showing geographic changes in average population densities between two 5-year periods: 1976-1980 and 1999-2003. Both map types were modeled using an Inverse Distance Weighting (IDW) approach with a Geographic Information System (Bonham-Carter, G. 1994). IDW has been used to map large scale data collection efforts such as the North American Breeding Bird Survey (Sauer 2003) as well as other arctic waterfowl surveys (Alisauskas 1997, Hines et al. 2004). We used the IDW interpolator in the Spatial Analyst 1.1 extension for ArcView 3.2 (Environmental Research Systems Institute 2000) to carry out the GIS analyses. Essentially, we needed to define three parameters in order to carry out the analyses: (1) a search radius around a given cell (point on a map) which determined the neighbouring data points to include in the analysis; (2) a cell size reflecting the ultimate resolution the maps; and (3) an exponent or power value. Transects were not regularly distributed, so we used a search radius that included the 15 – 20 data points that were nearest to the particular cell of interest rather than using a search radius defined by a fixed distance (e.g., 10 km). A cell size of 2000 m was chosen as it

provided adequate map resolution as well as an acceptable computer processing time. We found little guidance in the literature on what exponent value to use. We decided on an exponent of 2 as that has been conventionally used in the past. More details on the IDW method as applied to waterfowl surveys in the Northwest Territories are presented in Hines et al. (2004).

3. RESULTS

The scientific names of all species of waterfowl considered in this report are presented in Table 2 and maps indicating the distributions of 16 species or species groups of waterfowl are presented in Figures 2 – 17. The identities of some closely related species cannot be reliably separated from the air so these species are mapped as generic groups such as scaup, scoters, and mergansers (Table 2).

Maps showing changes in population densities are presented for 11 species or species groups: Mallard, American Wigeon, Northern Pintail, Green-winged Teal, Northern Shoveler, Canvasback, scaup, Ring-necked Duck, Bufflehead, Long-tailed Duck, and scoters. Some species (e.g. Blue-winged Teal) were not widely distributed or occurred at low densities, and could not be effectively treated in the trend map analyses.

In general, we attempted to map all species with a common map style. Because of their relatively high population densities, it was necessary to use different density classes to adequately portray the changes in densities of three numerous species or species groups (American Wigeon, scaup and scoters).

4. LITERATURE CITED

Alisauskas, Ray. 1997. Spatial interpolation for post-stratification of aerial survey data. Pages 383-387 in GIS '97 Conference Proceedings. Fort Collins, Colorado.

Bonham-Carter, G. 1994. Geographic information systems for geoscientists: Modelling with GIS. Pergamon Press. New York, N.Y.

Environmental Research Systems Institute 2000. ArcView 3.2 Spatial Analyst. Environmental Research Systems Institute. Redlands, California.

Hines, J.E., B. Fournier, and J. O'Neill. 2004. Spring and fall distribution of waterfowl and other aquatic birds on the mainland of the Inuvialuit Settlement Region, Western Canadian Arctic, 1990-98. Technical Report Series No. 426. Canadian Wildlife Service, Yellowknife, Northwest Territories.

Sauer, J.R., J.E. Hines, and J. Fallon. 2003. The North American Breeding Bird Survey, results and analysis 1966 - 2002. Version 2003.1, USGS Patuxent Wildlife Research Center, Laurel, Maryland.

Smith, G.W. 1995. A critical review of the aerial and ground surveys of breeding waterfowl in North America. Biological Science Report 5, National Biological Service, Washington, D.C. 252 pp.

Table 1. Stratum number, general habitat present, stratum area, and number of transects surveyed in the Northwest Territories as part of the Waterfowl Breeding Population and Habitat Survey, 1976-2003.

Stratum number	General habitat or ecozone	Stratum area (km^2)	Number of transects
13	Mackenzie Delta	12,782	4
14	Taiga Plains and Arctic Plains	205,172	8
15	Taiga Plains	130,696	2
16	Taiga Shield	149,756	4
17	Taiga Plains	178,795	5
18	Boreal Plains and Taiga Shield	30,388	2

Table 2. Species and species groups referred to in the text or figures.

Species	Scientific Name	Comment
Mallard	*Anas platyrhynchos*	
American Wigeon	*Anas americana*	
Northern Pintail	*Anas acuta*	
Green-winged Teal	*Anas crecca*	
Blue-winged Teal	*Anas discors*	
Northern Shoveler	*Anas clypeata*	
Canvasback	*Aythya valisineria*	
Scaup		includes Lesser Scaup (*Aythya affinis*) and Greater Scaup (*Aythya marila*).
Ring-necked Duck	*Aythya collaris*	
Bufflehead	*Bucephala albeola*	
Goldeneyes		includes Common Goldeneyes (*Bucephala clangula*) and Barrow's Goldeneyes (*Bucephala islandica*).
Long-tailed Duck	*Clangula hyemalis*	
Scoters		includes White-winged Scoters (*Melanitta fusca*), Surf Scoters (*Melanitta perspicillata*), and possibly small numbers of Black Scoters (*Melanitta nigra*).
Mergansers		includes Common Mergansers (*Mergus merganser*) and Red-breasted Mergansers (*Mergus serrator*) and smaller numbers of Hooded Mergansers (*Lophodytes cucullatus*)
Canada Goose	*Branta canadensis*	
Swans		primarily Tundra Swans (*Cygnus columbianus*) but may include very small numbers of Trumpeter Swans (*Cygnus buccinator*)

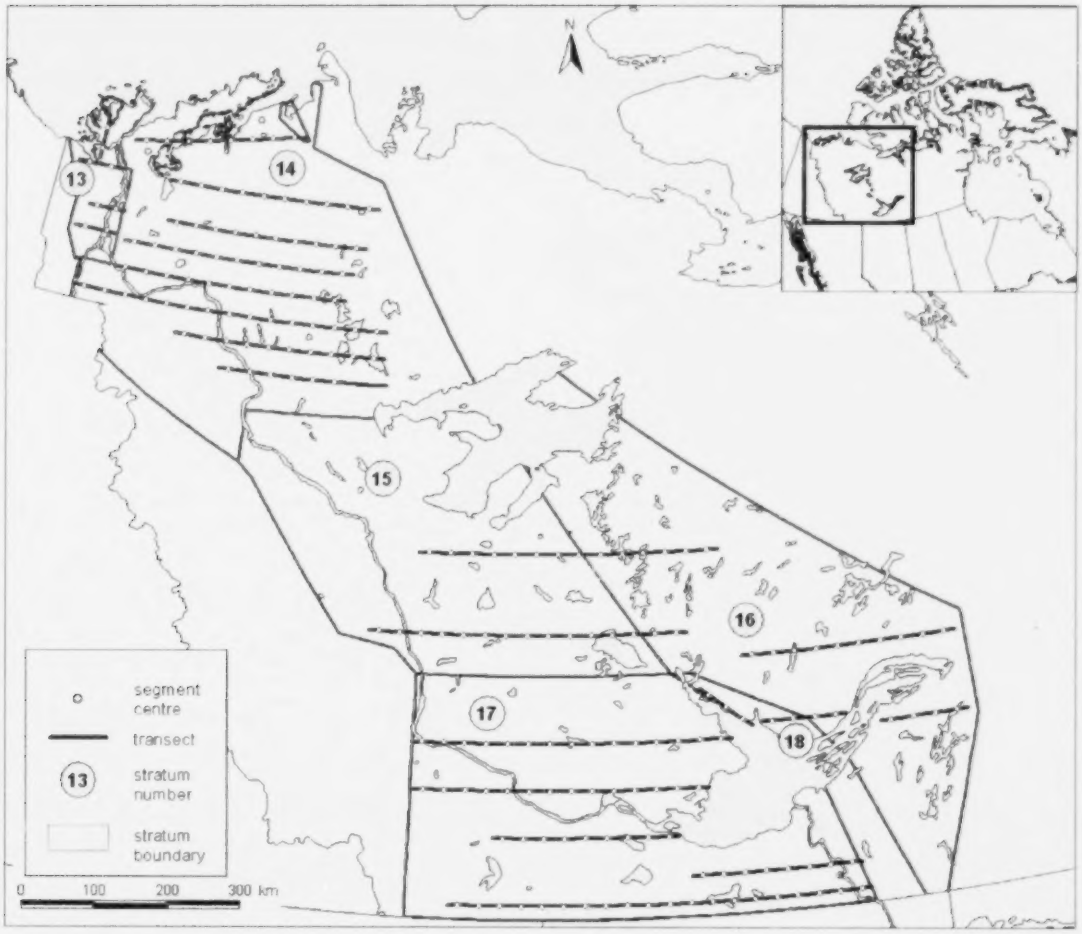

Figure 1. Study area, strata and transects for the Waterfowl Breeding Population and Habitat surveys within the Northwest Territories.

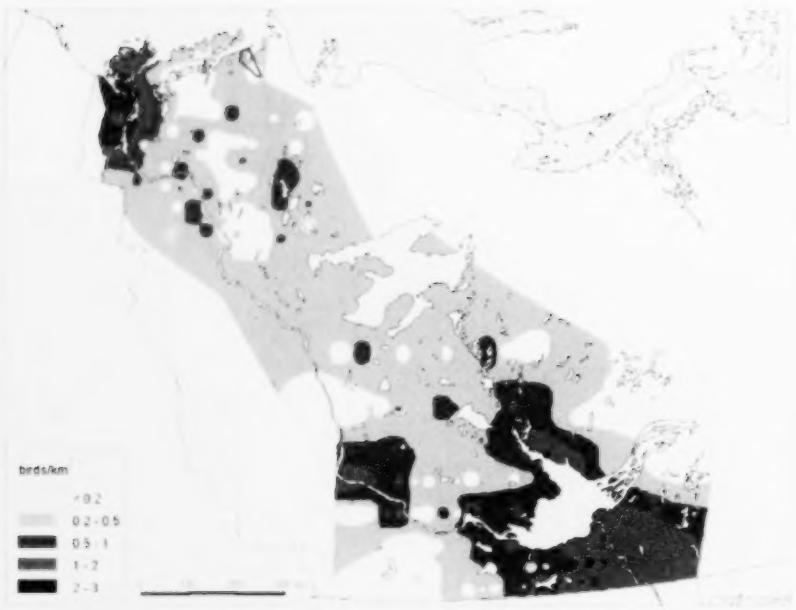

Figure 2. Geographic distribution of Mallards in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

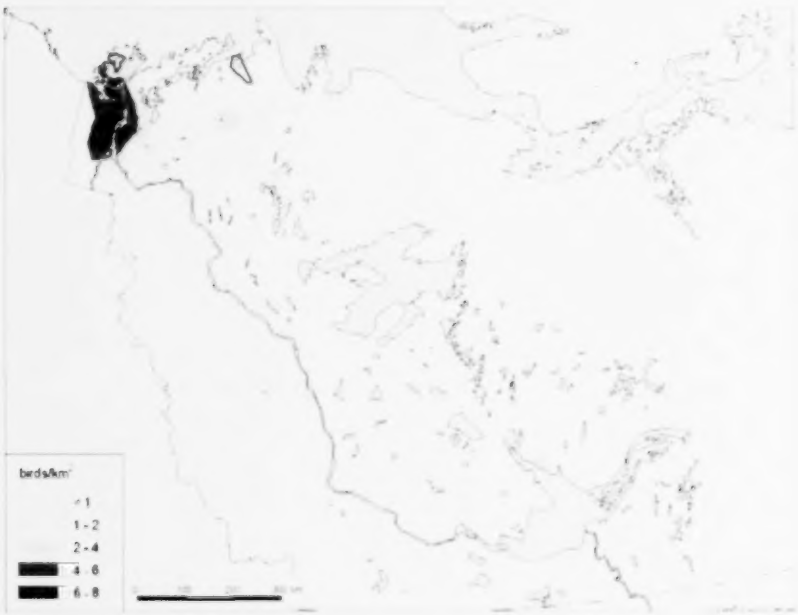

Figure 3. Geographic distribution of American Wigeon in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

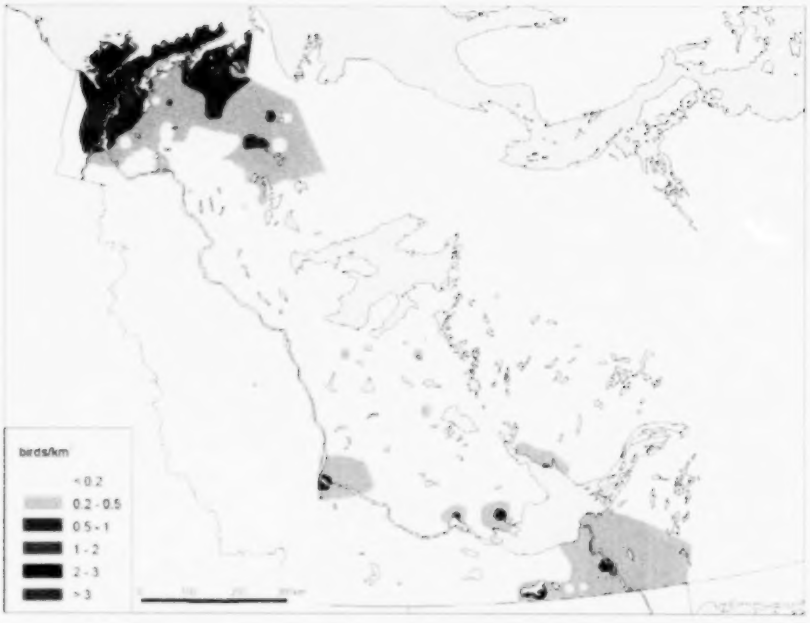

Figure 4. Geographic distribution of Northern Pintails in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

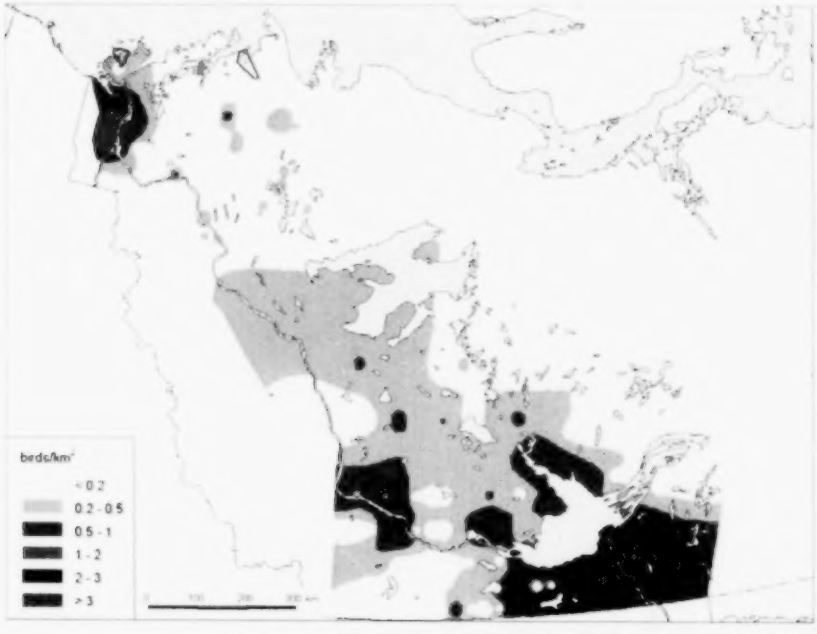

Figure 5. Geographic distribution of Green-winged Teal in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

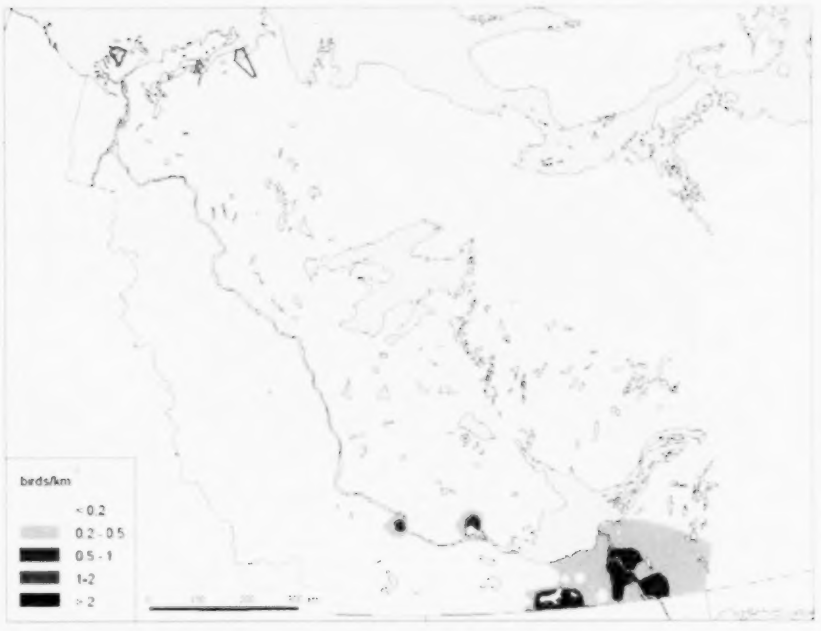

Figure 6. Geographic distribution of Blue-winged Teal in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

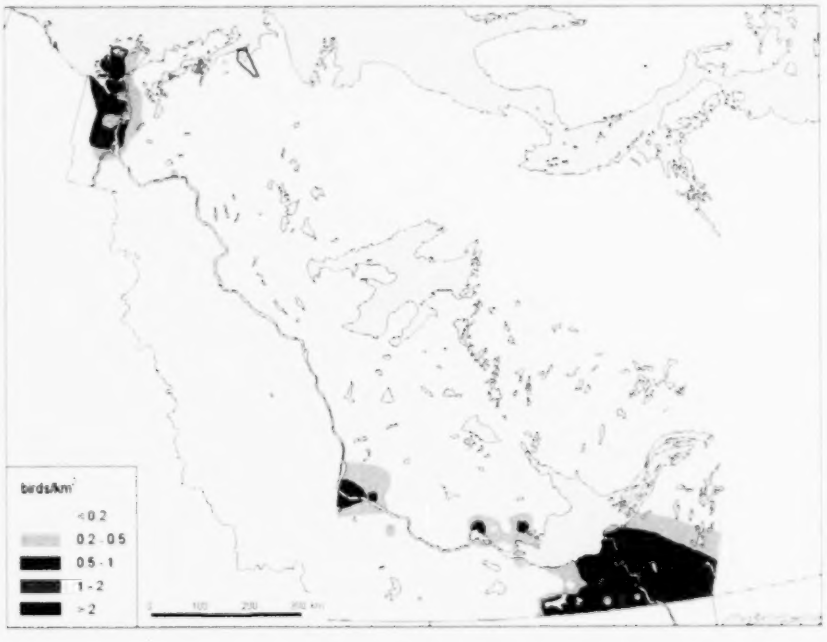

Figure 7. Geographic distribution of Northern Shoveler in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

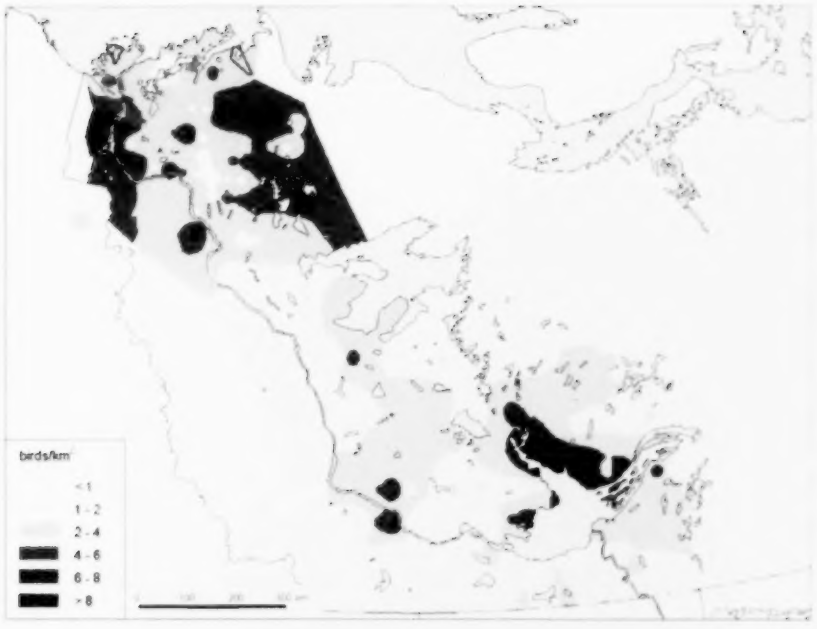

Figure 8. Geographic distribution of scaup in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

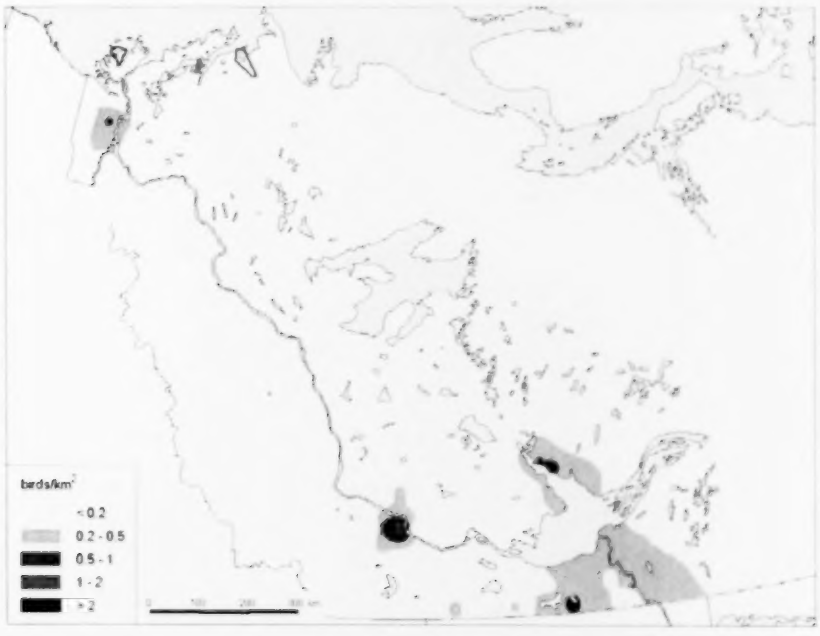

Figure 9. Geographic distribution of Ring-necked Ducks in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

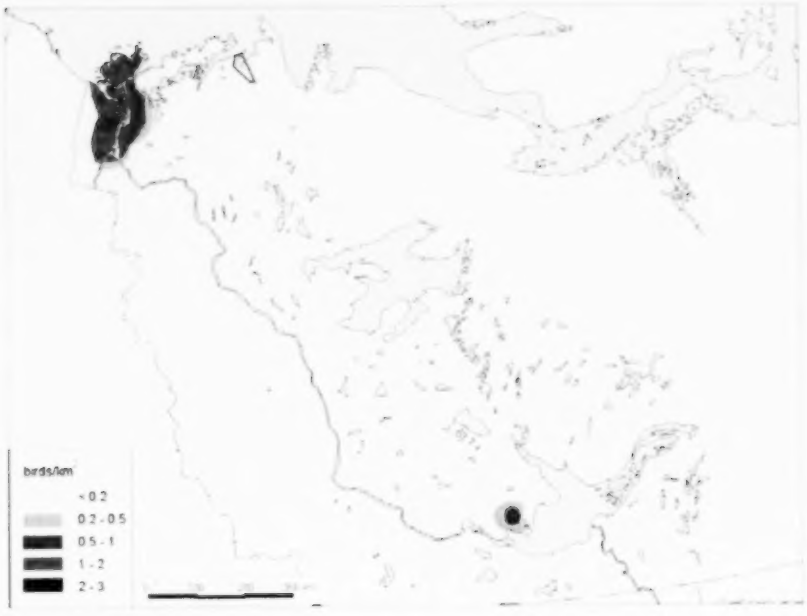

Figure 10. Geographic distribution of Canvasbacks in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

Figure 11. Geographic distribution of Buffleheads in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

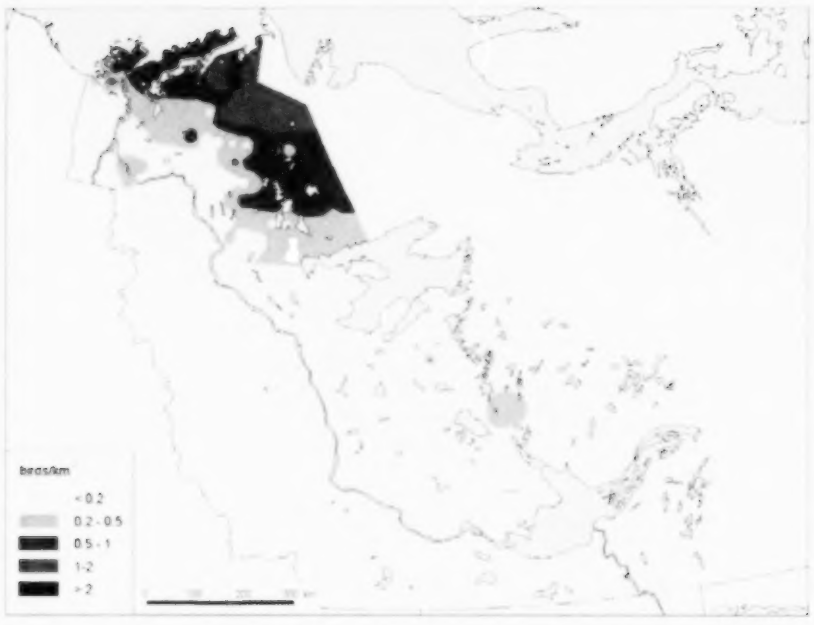

Figure 12. Geographic distribution of Long-tailed Ducks in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

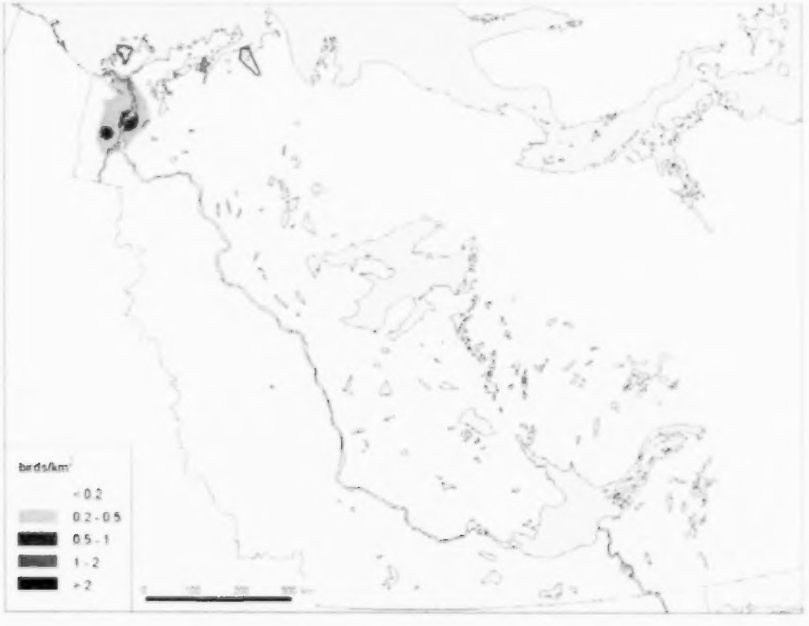

Figure 13. Geographic distribution of goldeneyes in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

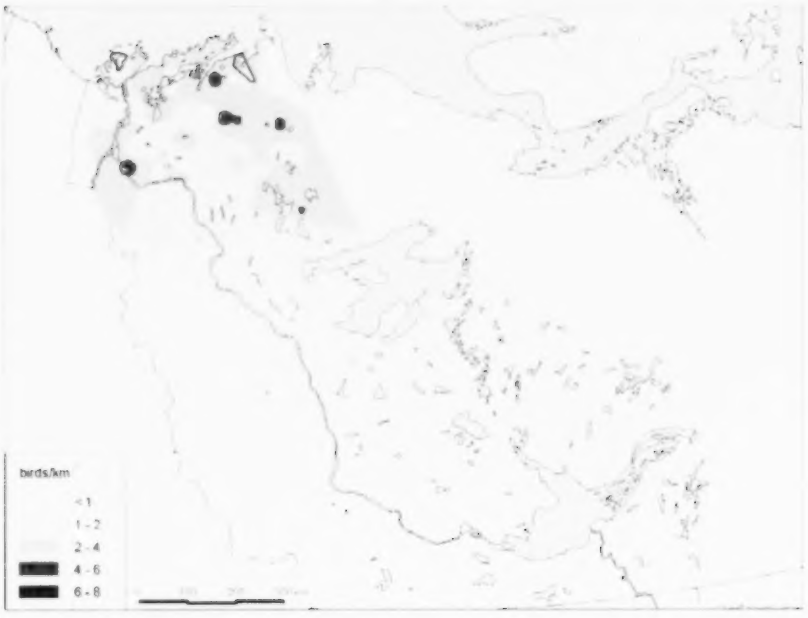

Figure 14. Geographic distribution of scoters in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

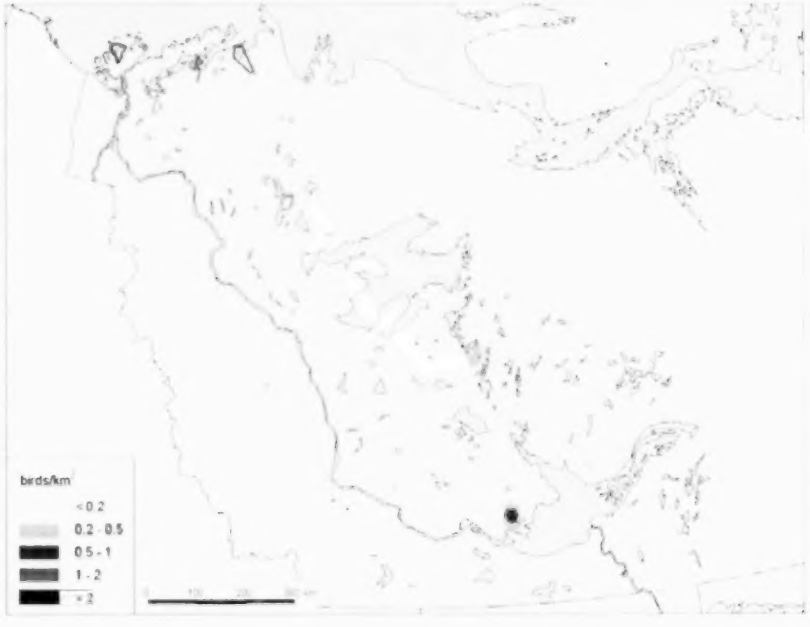

Figure 15. Geographic distribution of mergansers in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

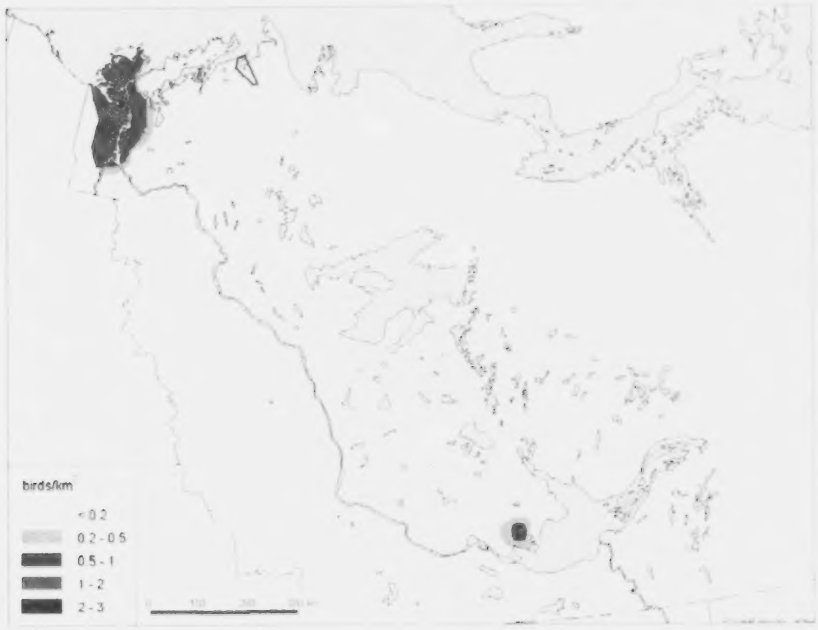

Figure 16. Geographic distribution of Canada Geese in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

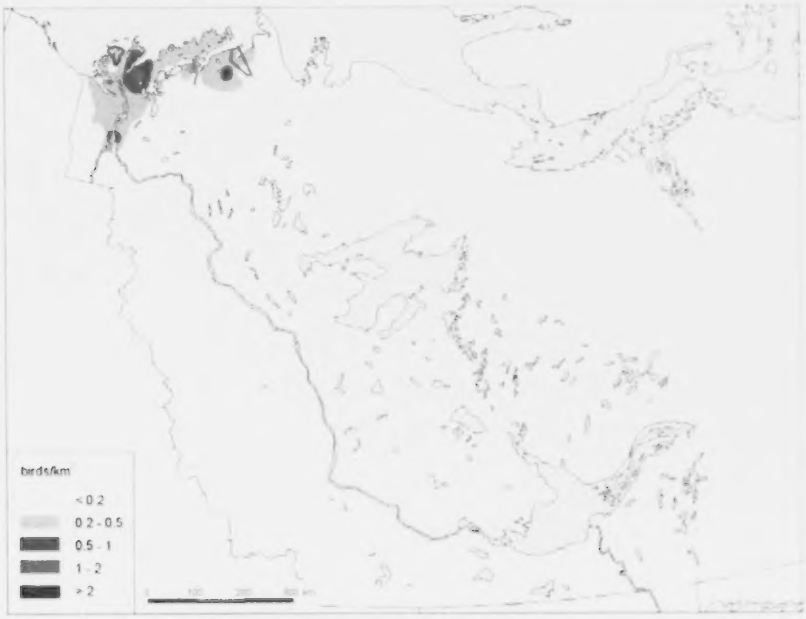

Figure 17. Geographic distribution of swans in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

Figure 18. Geographic distribution of all species of waterfowl in the Northwest Territories during the Waterfowl Breeding Population and Habitat Surveys, 1976-2003.

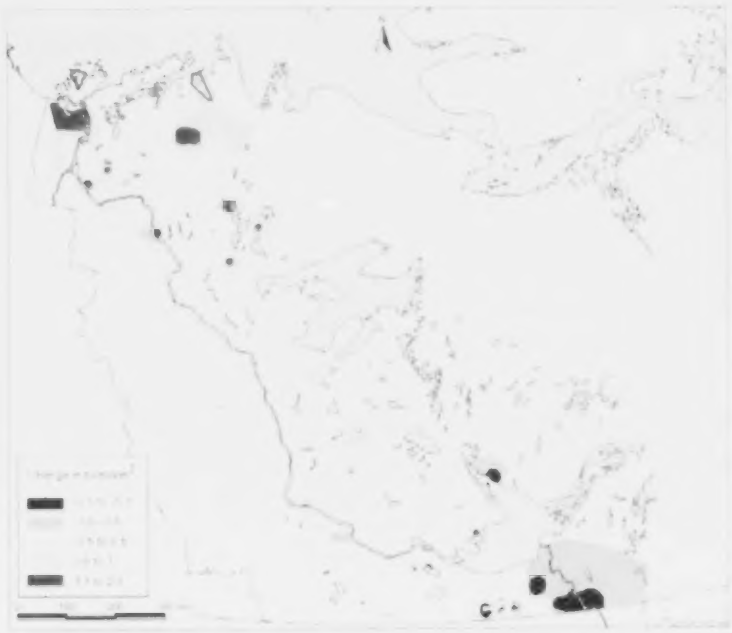

Figure 19. Geographic changes in population densities of Mallards in the Northwest Territories between 1976-1980 and 1999-2003.

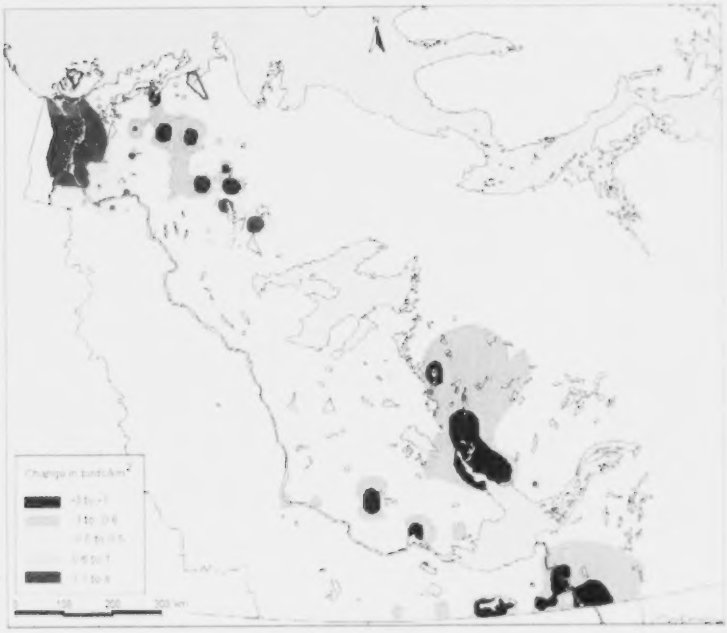

Figure 20. Geographic changes in population densities of American Wigeon in the Northwest Territories between 1976-1980 and 1999-2003.

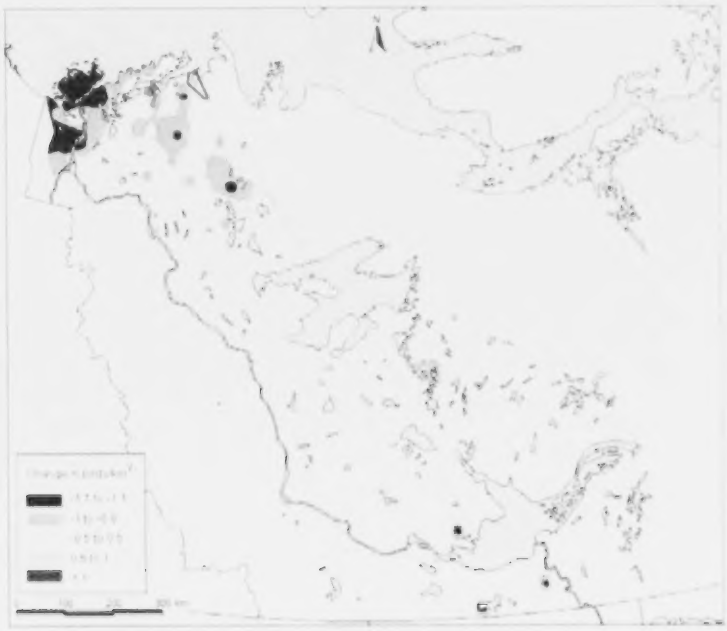

Figure 21. Geographic changes in population densities of Northern Pintails in the Northwest Territories between 1976-1980 and 1999-2003.

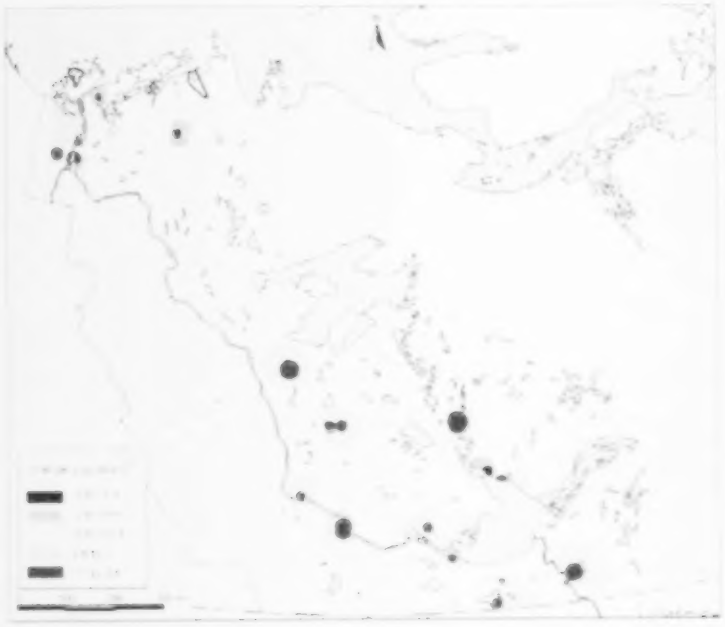

Figure 22. Geographic changes in population densities of Green-winged Teal in the Northwest Territories between 1976-1980 and 1999-2003.

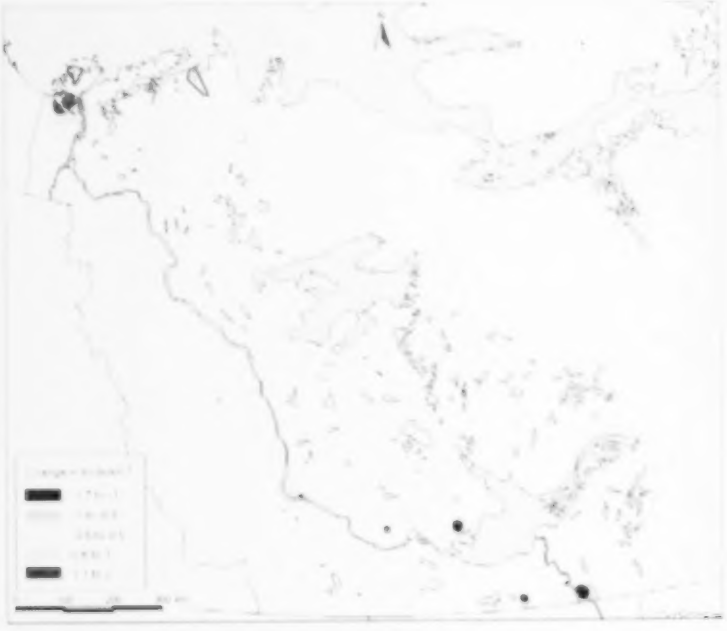

Figure 23. Geographic changes in population densities of Northern Shovelers in the Northwest Territories between 1976-1980 and 1999-2003.

Figure 24. Geographic changes in population densities of Canvasbacks in the Northwest Territories between 1976-1980 and 1999-2003.

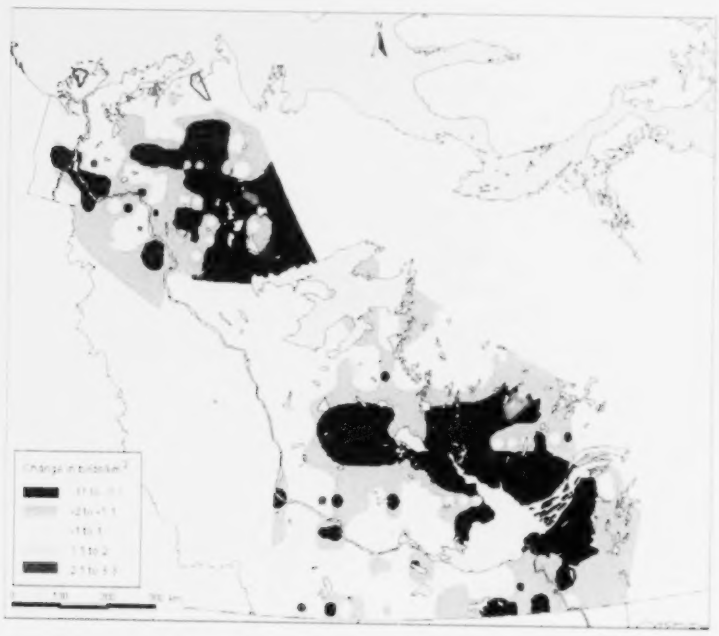

Figure 25. Geographic changes in population densities of scaup in the Northwest Territories between 1976-1980 and 1999-2003.

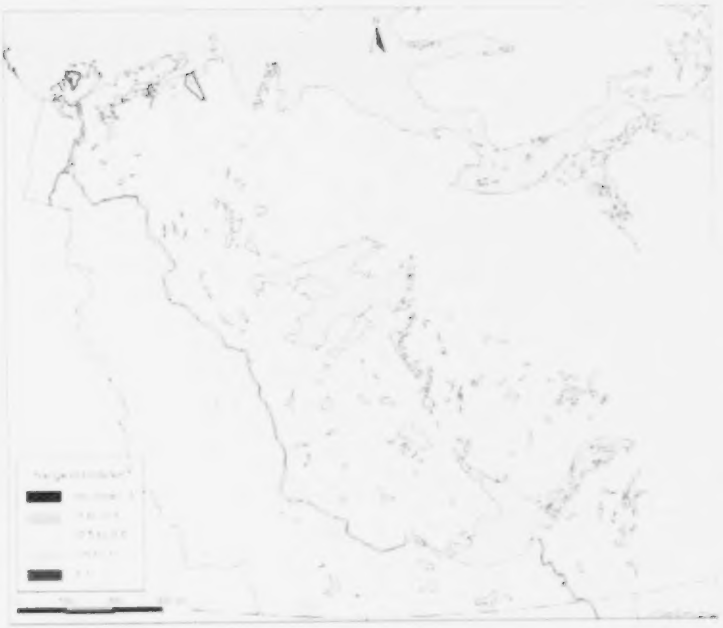

Figure 26. Geographic changes in population densities of Ring-necked Ducks in the Northwest Territories between 1976-1980 and 1999-2003.

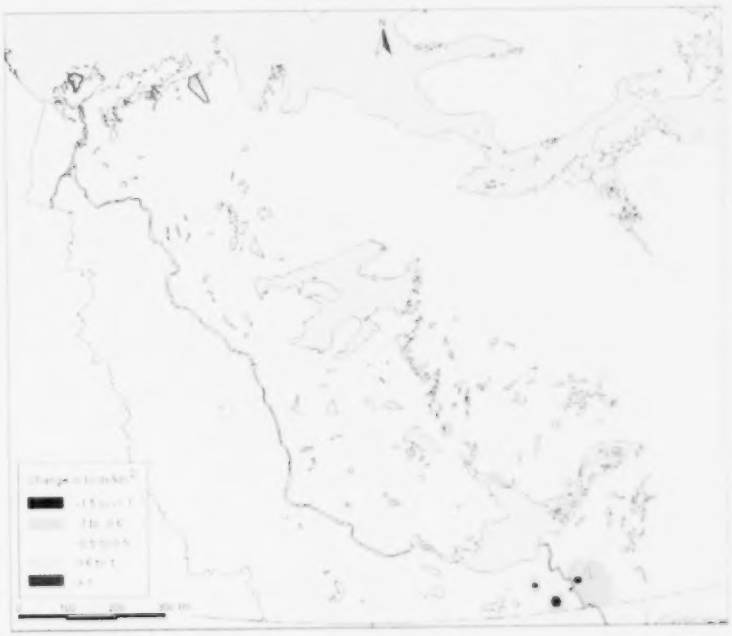

Figure 27. Geographic changes in population densities of Buffleheads in the Northwest Territories between 1976-1980 and 1999-2003.

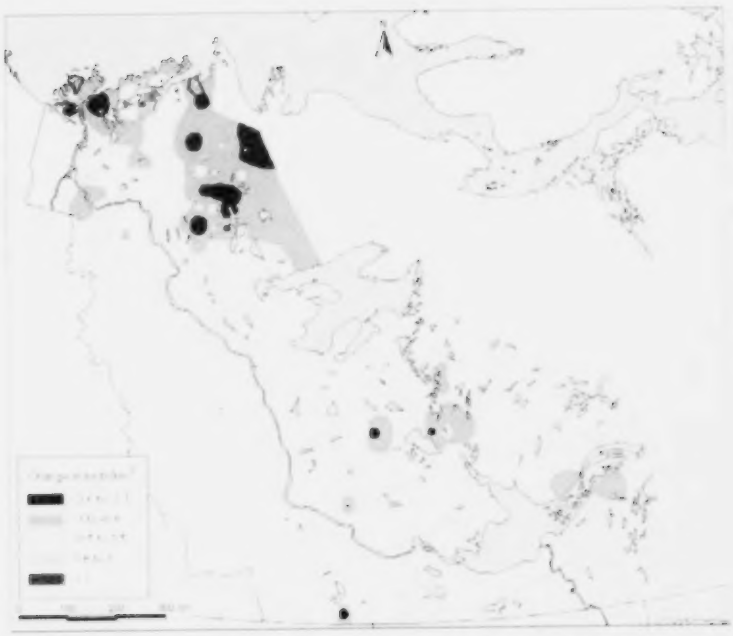

Figure 28. Geographic changes in population densities of Long-tailed Ducks in the Northwest Territories between 1976-1980 and 1999-2003.

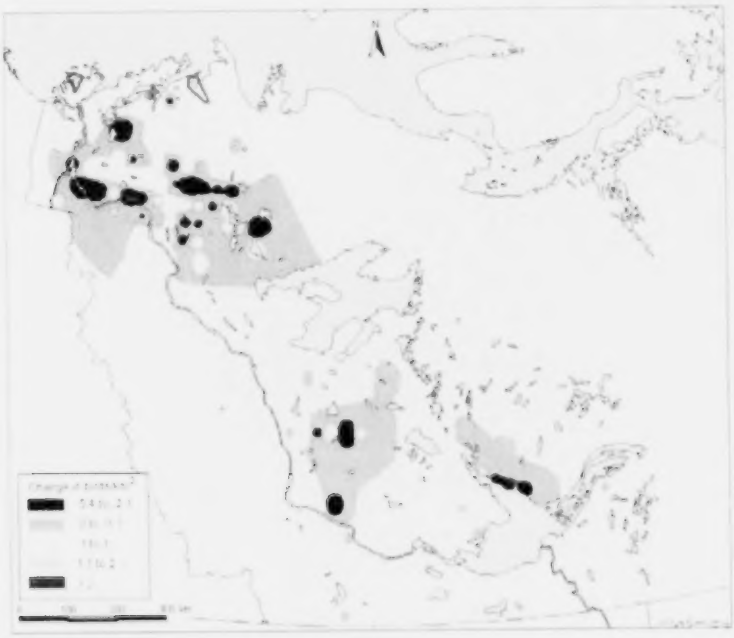

Figure 29. Geographic changes in population densities of scoters in the Northwest Territories between 1976-1980 and 1999-2003.

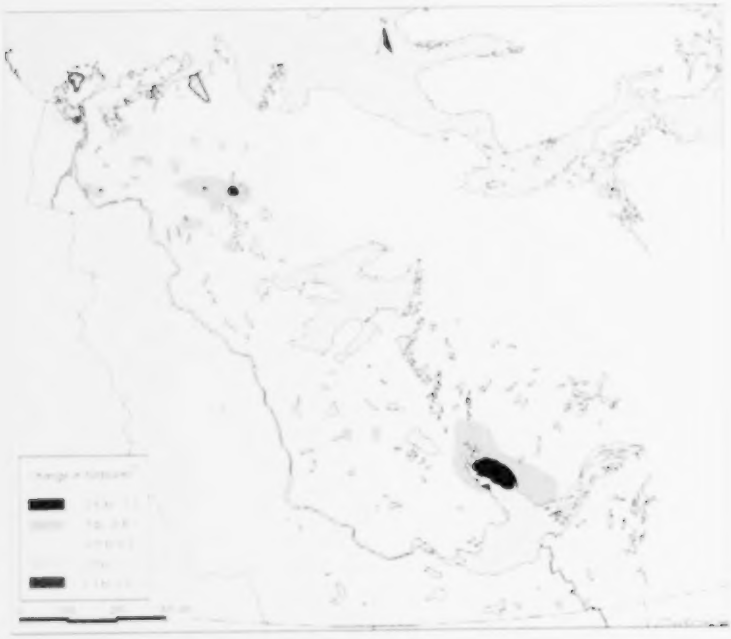

Figure 30. Geographic changes in population densities of all species of waterfowl in the Northwest Territories between 1976-1980 and 1999-2003.